

CLAIMS:

1. An electrophoretic display device (1) comprising an electrophoretic material comprising charged particles (8, 9) in a fluid (10), a plurality of picture elements, first and second electrodes (5, 6) associated with each picture element, the charged particles (8, 9) being able to occupy a position being one of a plurality of positions between said electrodes (5, 6), said positions corresponding to respective optical states of said display device (1), and drive means arranged to supply a drive waveform to said electrodes (5, 6), said drive waveform comprising: a) a sequence of drive signals, each effecting an image transition by causing said particles (8, 9) to occupy a predetermined optical state corresponding to image information to be displayed, and b) at least one voltage pulse preceding each drive signal, wherein the polarity and energy represented by each said voltage pulse is dependent on, and determined by a current optical state, and wherein each voltage pulse causes said particles (8, 9) to be moved in a direction away from the electrode (5, 6) nearest thereto.
2. A display device according to claim 1, wherein the drive waveform further includes a reset pulse, prior to one of the drive signals.
3. A display device according to claim 2, wherein a reset pulse, prior to a drive signal, comprises an additional reset duration.
4. A display device according to any one of the preceding claims, wherein the drive waveform further includes one or more shaking pulses.
5. A display device according to claim 4, wherein the drive waveform includes one or more shaking pulses prior to said voltage pulse.
6. A display device according to claim 4 or claim 5, wherein the drive waveform includes one or more shaking pulses between said voltage pulse and a subsequent drive signal.

7. A display device according to any one of claims 3 to 6, wherein an even number of shaking pulses are provided in the drive waveform.
8. A display device according to any one of claims 4 to 6, wherein the shaking pulse has an opposite polarity to the subsequent data pulse when a single shaking pulse is applied.
9. A display device according to any one of claims 3 to 8, wherein the length of the or each shaking pulse is of an order of magnitude shorter than the minimum time period of a drive signal required to drive the optical state of a picture element from one extreme optical state to the other.
10. A display device according to any one of claims 3 to 9, wherein the energy value of the or each shaking pulse is insufficient to significantly change the optical state of a picture element.
11. A display device according to any one of claims 3 to 10, wherein the time interval between the one or more shaking pulses and said voltage pulse is substantially zero.
12. A display device according to any one of claims 1 to 11, wherein image transitions include pixels without substantial optical state change.
13. A display device according to any one of claims 1 to 12, comprising two substrates, at least one of which is substantially transparent, whereby the charged particles (8, 9) are present between the two substrates.
14. A display device according to any one of claims 1 to 13, wherein the charged particles (8, 9) and the fluid (10) are encapsulated.
15. A display device according to any one of claims 1 to 14, wherein the charged particles (8, 9) and the fluid (10) are encapsulated in a plurality of individual microcapsules (7), each defining a respective picture element.

16. A display device according to any one of claims 1 to 15, having at least three optical states.

17. A display device according to any one of claims 1 to 16, wherein the drive
5 waveform is pulse width modulated.

18. A display device according to any one of claims 1 to 16, wherein the drive waveform is voltage modulated.

10 19. A display device according to any one of the preceding claims, wherein at least one individual drive waveform is substantially dc-balanced.

20. A display device according to any one of the preceding claims, wherein at least some of the sub-sets of closed loops wherein an image transition cycle causes a pixel to
15 have substantially the same optical state at the end of said cycle as at the beginning, are substantially dc-balanced.

21. A method of driving an electrophoretic display device (1) comprising an electrophoretic material comprising charged particles (8, 9) in a fluid (10), a plurality of
20 picture elements, first and second electrodes (5, 6) associated with each picture element, the charged particles (8, 9) being able to occupy a position being one of a plurality of positions between said electrodes (5, 6), said positions corresponding to respective optical states of said display device (1), the method comprising supplying a drive waveform to said electrodes (5, 6), said drive waveform comprising: a) a sequence of drive signals, each effecting an
25 image transition by causing said particles (8, 9) to occupy a predetermined optical state corresponding to image information to be displayed, and b) at least one voltage pulse preceding each drive signal, wherein the polarity and energy represented by each said voltage pulse is dependent on, and determined by a current optical state, and wherein each voltage pulse causes said particles (8, 9) to be moved in a direction away from the electrode (5, 6)
30 nearest thereto.

22. Apparatus for driving an electrophoretic display device (1) comprising an electrophoretic material comprising charged particles (8, 9) in a fluid (10), a plurality of picture elements, first and second electrodes (5, 6) associated with each picture element, the

charged particles (8, 9) being able to occupy a position being one of a plurality of positions between said electrodes (5, 6), said positions corresponding to respective optical states of said display device (1), the apparatus comprising drive means arranged to supply a drive waveform to said electrodes (5, 6), said drive waveform comprising: a) a sequence of drive signals, each effecting an image transition by causing said particles (8, 9) to occupy a predetermined optical state corresponding to image information to be displayed, and b) at least one voltage pulse preceding each drive signal, wherein the polarity and energy represented by each said voltage pulse is dependent on, and determined by a current optical state, and wherein each voltage pulse causes said particles (8, 9) to be moved in a direction away from the electrode (5, 6) nearest thereto.

23. A drive waveform for driving an electrophoretic display device (1) comprising an electrophoretic material comprising charged particles (8, 9) in a fluid (10), a plurality of picture elements, first and second electrodes (5, 6) associated with each picture element, the charged particles (8, 9) being able to occupy a position being one of a plurality of positions between said electrodes (5, 6), said positions corresponding to respective optical states of said display device (1), the apparatus comprising drive means arranged to supply said drive signal to said electrodes (5, 6), said drive waveform comprising: a) a sequence of drive signals, each effecting an image transition by causing said particles (8, 9) to occupy a predetermined optical state corresponding to image information to be displayed, and b) at least one voltage pulse preceding each drive signal, wherein the polarity and energy represented by each said voltage pulse is dependent on, and determined by a current optical state, and wherein each voltage pulse causes said particles (8, 9) to be moved in a direction away from the electrode (5, 6) nearest thereto.